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## VOLCANIC PRODUCTS FROM THE HAWAIIAN ISLANDS.

BY E. GOLDSMITH.

*Kauaiite*.—As the Hawaiian Islands are known to be of volcanic origin, the appearance in a crater of a substance resembling chalk may occasion surprise.

Professors Benj. Sharp and W. Libbey, Jr. who visited a number of the Pacific Islands during the past year, secured, on the Island of Kauai, a specimen which, in external appearance, very much resembles chalk. Although definite information as to its relation to adjacent solfataras and cracks is desirable it has not been obtained, nor is it known whether the material is rare or abundant.

The specimen weighed but a few ounces. To the eye it appears to be amorphous and made up of an extremely fine powder which soils the fingers when touched. Despite its softness the particles adhere firmly, its hardness being about 0.5. It can be easily cut with a knife into any shape, precisely like chalk. It is perfectly dull to the reflected ray of light; the color is nearly white or, to be exact, of a faint cream tint. One side of the specimen is covered with a thin coating of brown oxide of iron. The streak is white and its lines on a black-board cannot be distinguished from lines made with white chalk. Only formless granules are revealed under the microscope and, strange to say, increasing power serves but to show more of the granules in the field without any increase in size. In all of the granules the diameters seem to be about the same.

If the material be imbedded in balsam and interposed between the crossed Nicol prisms, light is transmitted. The ray of light transmitted under these conditions is pale blue and no other color of polarization is produced. By this means the particles can be observed to the best advantage, as, when projected on a dark background, singly and in groups, the contrast favors observation. In the manner that the modern chemist describes the molecule do these fine particles form groups and the picture presented in the field of view so strikingly resembles the molecular conception of the present day as to almost tempt one to believe that the atom had at last become visible, provided we assumed that the fine particles

of the material, as revealed under the microscope, are atoms. It possesses no dichroism. Specific gravity 2.566.

When heated in a Bunsen flame it slightly decrepitates and emits the yellow light due to sodium. When heated in a test tube it gradually becomes dark gray, indicating some carbonaceous matter and, when heated strongly, an oily matter and water having an acid reaction are emitted. Heated with the blowpipe on charcoal with carbonate of soda it effervesces and finally produces a white enamel. Heated by itself, on the charcoal, it produces an intense white incandescence and, reheated with cobalt solution, a fine blue is obtained.

It is not soluble in water, sulphuric, hydrochloric or nitric acids, but if boiled with a caustic alkali it dissolves. If, however, the substance is brought to a red heat and there maintained for some time, it is then dissolved by any of the above named acids.

The chemical analysis, made in duplicate, resulted as follows:

|                                 |   |       |           |
|---------------------------------|---|-------|-----------|
| Alumina                         | (AL <sub>2</sub> O <sub>3</sub> )                 | 33.40 | per cent. |
| Sulphate alumina                | (AL <sub>2</sub> O <sub>3</sub> SO <sub>3</sub> ) | 7.18  | " "       |
| Sulphate potassium              | (K <sub>2</sub> SO <sub>4</sub> )                 | 17.00 | " "       |
| Sulphate sodium                 | (NA <sub>2</sub> SO <sub>4</sub> )                | 4.91  | " "       |
| Water                           | (H <sub>2</sub> O)                                | 31.57 | " "       |
| Carbonaceous matter, difference |   | 5.94. |           |

The carbonaceous matter was not especially determined in the belief that in all probability it is an accidental admixture foreign to the composition of the original substance.

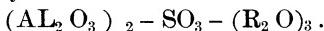
From the analysis above given it is evident that the compound is a highly basic sulphate, and, eliminating the percentage of carbonaceous matter and finding the oxygen ratios between the sulphur trioxide, the alumina and all the monoxides, the composition determined is as follows:

|                  |                                   |       |           |       |           |         |
|------------------|-----------------------------------|-------|-----------|-------|-----------|---------|
| Alumina          | (AL <sub>2</sub> O <sub>3</sub> ) | 39.79 | per cent. | 18.68 | per cent. | Oxygen. |
| Potassium oxide  | (K <sub>2</sub> O)                | 7.37  | " "       | 1.25  | " "       | "       |
| Sodium oxide     | (NA <sub>2</sub> O)               | 1.72  | " "       | 0.44  | " "       | "       |
| Water            | (H <sub>2</sub> O)                | 33.56 | " "       | 29.82 | " "       | "       |
| Sulphur trioxide | (SO <sub>3</sub> )                | 17.55 | " "       | 10.52 | " "       | "       |

The ratios of the SO<sub>3</sub>, AL<sub>2</sub>O<sub>3</sub>, R<sub>2</sub>O are nearly as:

1,      2,      3

which may be represented by the formula:



Here R<sub>2</sub> represents K<sub>2</sub>, NA<sub>2</sub>, H<sub>2</sub>.

There are a number of basic sulphates recorded, all of which seem

to be soluble in acids, although the one under discussion is not. I would, therefore, propose *Kauaiite* as a name for the new variety. The extremely fine division and the approach to crystallization without forming true geometrical solids may suggest the mode of its formation. It may, with the exception of the carbonaceous matter, be ejected as volcanic. An objection might be based on the large percentage of water, but we must remember that in some volcanoes water is an almost constant ingredient of their ejections, and we may, therefore expect to occasionally meet with so-called hydrous compounds in the material thrown out. The aluminium may have been distilled by the intense volcanic heat together with the other elementary metals and metalloid sulphur. Coming in contact with the atmosphere, the material was oxydized and quickly precipitated on the cooler surface of the earth, giving no time for the formation of crystals. If corundum is reduced and volatilized by the heat produced in the electrical furnace, we may expect similar results from the enormous heat energy of a volcano.

*Volcanic Stalactites.*—That the highly heated and very fluid lava in the crater of Kilauea, as well as in other craters, is occasionally shot up into the air some thirty feet or more, has been reported at various times and has also been observed by the gentlemen before referred to. Such lava in its descent through the air becomes very porous. If such a highly porous rock have a space underneath, a fresh deposit of liquid lava will trickle through the porous cooled lava, forming as it solidifies the pendent stalactites shown in Plate VI. These stalactites are about one-fourth of an inch thick and about eight inches long. They show no disposition to form cones like those usually seen in limestone caves. These slender, gnarled, rod-shaped formations are mostly hollow and porous and so brittle that it is difficult to prepare a thin section for microscopical study. The color is usually a deep black, sometimes a part is of a brownish tint, due, probably, to a higher oxidation of the magnetite present. Occasionally a gray color is noticed but this is caused by the incrustation of some other substance. To ascertain its probable mineralogical composition, it was necessary to use the fine powder, imbedding it as usual in balsam. The fragments examined beneath the microscope indicate a glassy feldspar having apparently the characteristic of sanidine. They contain magnetite in great profusion and also gases, probably air. A dichroic mineral is also recognizable in the mixture,

but whether it is augite or not is at present uncertain. A fragment weighing 2.459 grams in air, and 1.297 grams in distilled water had a specific gravity of 2.11, evidently far too low for lava as generally known, undoubtedly due to the extremely porous nature of the material. By producing a coarse powder and taking the specific gravity in a pycnometer, the result is 2.85.

Considered from a chemical standpoint, this lava is decidedly basic, as the quantity of silica determined analytically was 48.55 per cent.

The specific character of this rock, now shown in the form of stalactites is that of the so-called vesicular basalt.

On some of these volcanic stalactites, there had formed a thin layer of colorless crystals so small that their form could be recognized only under power.

These thin prismatic crystals are attached to one end and terminated by short pyramids; on certain faces they are longitudinally striated. In the groups are frequently seen twin crystals whose dual faces are mostly the longer axis. Figure 1, magnified about 4 diameters, shows how the crystals are attached to the volcanic stalactites. A slide, prepared and observed under a power of about 45 diameters shows the twin-formations of the crystals, Fig. 2. That these crystals belong to the monoclinic system is evident from the fact of their inclined extinction which, upon measurement, was found to be  $37^{\circ}$ , the longer axis of the crystals being zero to extinction over the pyramid. The colors of polarization were brilliant. Dichroism was unnoticed in these forms.

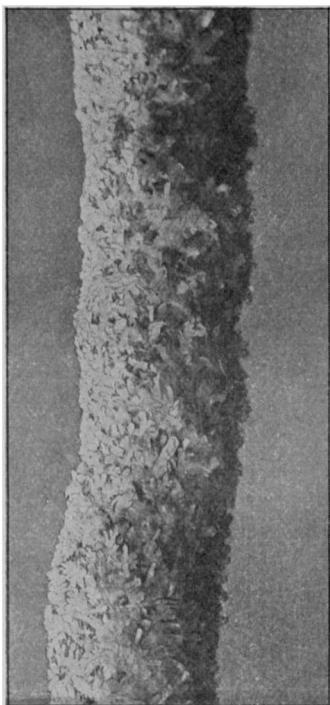


Fig. 1. Volcanic stalactite covered with selenite, x 4.

With the aid of Toulet solution the specific gravity of the material

at my command (about 8 milligrams) was found to be 2.285. It is soluble in water and gives the reactions indicating sulphur trioxide and calcium oxide. The incrusting small crystals are, therefore, selenite.

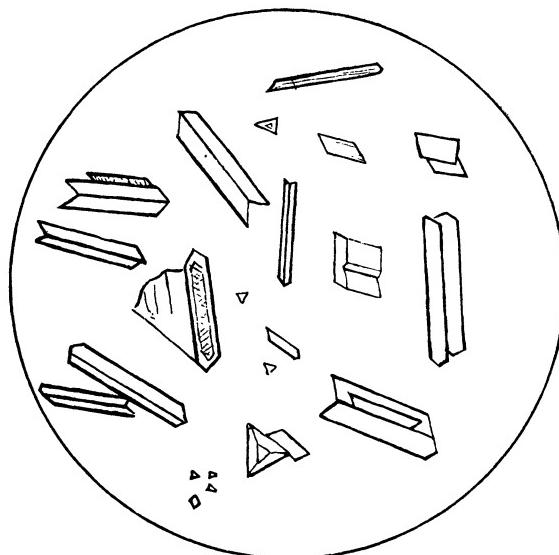
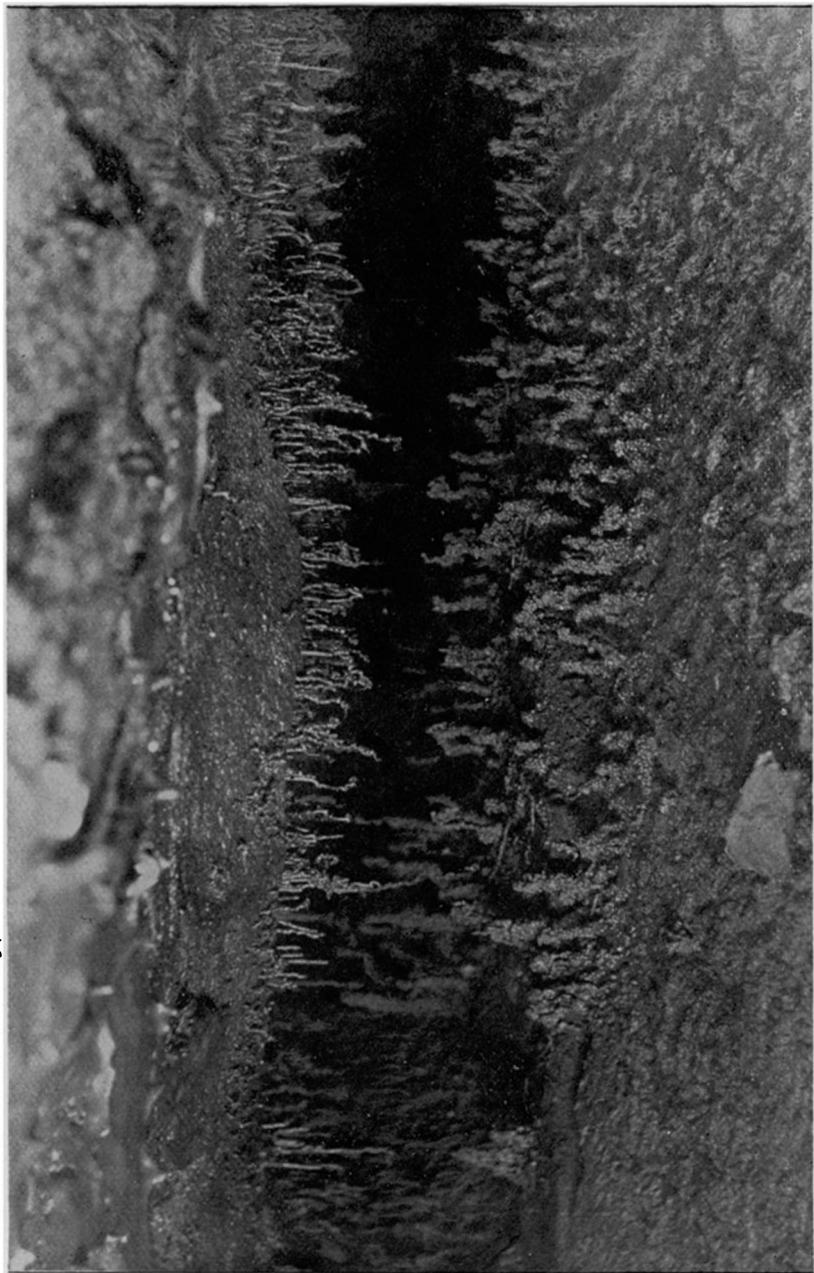


Fig. 2. Crystal and twin forms of selenite, x 45.

I am indebted to Professors Sharp and Libbey for the material studied and also for the photographs of the volcanic cave.

Plate VI shows the entrance to the cave with its overhanging roof of porous basalt from which are suspended the irregularly gnarled rods of volcanic stalactite; on the floor are scattered fantastic-shaped volcanic stalagmites which seem to be much thicker than the pendant rods above.



GOLDSMITH: VOLCANIC PRODUCTS OF HAWAIIAN ISLANDS.